

Nokia 7950 Extensible Routing System

Release 16

The Nokia 7950 XRS is a next-generation core routing platform that delivers the scale, efficiency and versatility needed to stay ahead of evolving service demands driven by the cloud, 5G and the Internet of Things.

Scale, efficiency and versatility are critical success factors for network operators in order to sustain profitable growth in a fiercely competitive market where the only constant is change.

Proven innovations lie at the heart of the 7950 XRS family, from its silicon to its software and its integration capabilities. The 7950 XRS allows a core network to be built with the ability to meet capacity demands well into the next decade while covering the full range of capabilities to cost-effectively address IP routing, Internet peering, multiprotocol label switching (MPLS) and infrastructure service requirements on a common core platform.

The conventional wisdom is that cost-efficient scaling of core networks can only be achieved by reducing the scope of functionality and range of flexibility. However, just adding more capacity inevitably results in unwieldy, multi-tier core networks with rapidly diminishing returns and poor investment protection. Powered by FP4, Nokia's industry-leading 2.4 Tb/s routing silicon, the 7950 XRS achieves scale and efficiency without compromising versatility. FP4 silicon offers six times the scale and double the efficiency of FP3 hardware. FP4 hardware is backwards compatible with FP3 features and adds enhanced packet intelligence and control capabilities to optimize traffic flows and protect network infrastructure against DDoS attacks. This enables network operators to rethink existing restrictions and conventions and build a capable and converged core network that can scale in a smart way, with superior returns on investments.

The 7950 XRS is deployed globally by telecom, cable, mobile, utility and private network operators of any size as well as major web-scale operators and internet exchange providers.



7950 XRS family overview

The 7950 XRS family is designed to meet the needs of global, national, regional and private network operators of all sizes.

The common platform addresses the full spectrum of networking needs for public and private internet backbones and peering points, metropolitan and regional aggregation hubs as well as cloud, data center and mobile core infrastructure. This will enable network operators to deliver the immersive ultra-broadband service experiences that consumers aspire to today and will expect tomorrow.

One platform for all services

The 7950 XRS addresses the full range of core routing requirements using common hardware that is powered by Nokia's FP4 and/or FP3 routing silicon and runs the proven, resilient and feature-rich Service Router Operating System (SR OS).

A flexible, pay-as-you-go software licensing model allows you to build a versatile, reliable and converged core network that evolves with your needs while protecting your hardware investments.

Scale with superior economics

A modular and extensible hardware design ensures granular and economical scaling of switching capacity and port density. A single 7950 XRS-20e chassis equipped with FP4 hardware delivers up to 96 Tb/s half duplex switching capacity, and supports port densities of up to 480 100GE or 4800 10GE interface ports, with flexible 10GE and 40GE breakout options provided by universal QSFP28 ports. Equipped with six-port CFP8 XRS Media Adapters (XMAs), a single chassis supports up to 120 400G clear channel interfaces with SR, LR or FR optics.

IP/optical integration

Tunable 10G and integrated 100G coherent PM-QPSK tunable DWDM optics enable the 7950 XRS to directly interface with the photonic transport layer without requiring optical transponders.

A standards-based GMPLS user-network interface (UNI) enables IP/optical control plane integration, allowing the 7950 XRS to efficiently coordinate IP routing and transport requirements across administrative boundaries and to dynamically set up optical segments and end-to-end transport connections.

Cross-domain management

The 7950 XRS is managed by the Nokia Network Services Platform (NSP), supporting integrated element and network management with end-to-end orchestration of network resource provisioning and assurance operations. Operational tools, including the Nokia 5650 Control Plane Assurance Manager (CPAM), provide additional visibility and flexibility in monitoring and troubleshooting IP control plane issues.

Carrier SDN integration and automation

The 7950 XRS and SR OS enable multivendor software-defined networking (SDN) control integration through OpenFlow, Path Computation Element Communication Protocol (PCEP) and model-driven network element management through CLI, NETCONF and gRPC/gNMI using YANG models. Network operators can leverage the 7950 XRS in combination with the NSP to introduce scalable and integrated carrier SDN control across IP, MPLS, Ethernet and optical transport layers.

The NSP supports unified service automation and network optimization with comprehensive path computation capabilities to enable source-based routing and traffic steering with segment routing support, online traffic engineering and resource optimization, and elastic bandwidth services for dynamic cloud applications. The NSP is further assisted by Deepfield analytics to support insight-driven automation of network and flow optimization, as well as DDoS attack mitigation.



7950 XRS-20e

The Nokia 7950 XRS-20e delivers up to 96 Tb/s half duplex routing capacity in a single 19-in rack.

The XRS-20e offers 20 slots with enhanced power and cooling capacity to support 2400 Gb/s full duplex aggregate interface capacity. Fully equipped with FP4 hardware, it offers up to 480 100GE, 120 400GE or 4800 10GE wire rate ports in a single rack, with additional 10G and 40G breakout options.

The XRS-20e comes in two chassis variants: a universal variant supporting all AC and DC power options and an AC/HVDC variant. The XRS-20e is functionally compatible with the XRS-20. All hardware components except the fan trays and XRS Control Modules are common and interchangeable.



7950 XRS-20

The Nokia 7950 XRS-20 provides up to 64 Tb/s half duplex routing capacity in a single 19-in rack.

Each XRS-20 system offers 20 slots, each capable of 1600 Gb/s full duplex aggregate interface capacity. Fully equipped with FP4 hardware, it offers up to 320 100GE, 80 400GE or 3200 10GE ports in a single rack.

The 7950 XRS-20 supports a mix of FP4 and FP3-based XCMs and XMAs in the same chassis by exchanging the SFM cards for FP4 variants. All other hardware components including CPM, CCM, fans and APEQs can be reused to maximize investment protection.

Common elements and attributes

The 7950 XRS core router family shares fundamental attributes that ensure consistency, operational ease of use, and investment protection for network operators.

Routing silicon

The 7950 XRS leverages Nokia's industry-leading FP4 NPU routing silicon to ensure optimal performance and scaling of a rich and complete Layer 2 and Layer 3 feature set that addresses all core deployment scenarios. The 2.4 Tb/s FP4 chipset is Nokia's fourth-generation NPU leveraging state-of-the-art 16nm 2.5/3D FinFET silicon technology. It is the industry's first multi-terabit routing silicon, and provides the perfect geometry for high-density 100G and 400G interface modules, with support for 1 Terabit Ethernet (TE) line rates as standards become available. It offers deterministic forwarding performance with enhanced packet intelligence and control capabilities for advanced traffic management and granular DDoS filtering policies.

These silicon innovations drive the high level of flexibility and performance needed for converged backbone and metro core deployments, including IP routing and peering, MPLS switching, VPN infrastructure services and data center interconnection applications.

Interface modules

The Nokia 7950 XRS uses a pair of complementary modules to support current and future interfaces. XMA Control Modules (XCMs) contain a slot-level control plane subsystem and switch fabric interface. Expandable Media Adapters (XMA) contain the forwarding complex and provide a wide range of GE, 10GE, 40GE, 100GE and 400G interface options.

A flexible software licensing scheme allows for customizing XMA for diverse core router applications, with configurable quality of service (QoS) granularity. This enables operators to consolidate core routing systems on a single platform, and to rapidly respond to evolving requirements with minimal impact and maximum investment protection.

Operating system

The 7950 XRS family is based on the proven SR OS, carrying forward over a decade of experience in the IP networks of more than 750 network operators worldwide. With a single common OS across the Nokia routing portfolio, network operators benefit from an extensive track record of reliability in the field and a full suite of features to enable resiliency, high availability and in-service software upgrade (ISSU).

Power and cooling efficiency

The 7950 XRS system design incorporates intelligent power management capabilities to monitor power consumption of individual components, assure power safety thresholds, and manage power-up and power-down priorities in the event of degraded power availability. Other key enhancements include clock gating techniques that dynamically reduce power to system components not in use.

Redundant, modular fan trays that are linearly modulated provide appropriate and efficient cooling with reduced noise levels. The 7950 XRS-20 uses two linear, 1+1 redundant fan trays in a stacked configuration for primary system cooling while the XRS-20e uses three impeller fan trays in a side-by-side configuration.

A "pull" airflow design, in combination with impedance panels and air guides, ensures an even distribution of air to every section of the system. Hot air exhaust through the back of the chassis ensures a clean separation between the hot and cold aisles. An optional top plenum accessory is available for the 7950 XRS-20 to enable hot air exhaust at the top of the chassis for additional cooling efficiency.

Hardware overview

All common equipment components are redundant and field-replaceable to maximize system uptime.

Chassis Control Modules (CCMs)

Redundant CCMs support operator access to the Nokia 7950 XRS control and management interfaces. The CCMs are located at the top, and each CCM has an LCD touch-screen display and supports interfaces for timing, management, alarms and memory expansions.

Advanced Power Equalization Modules (APEQs)

APEQs provide power for the 7950 XRS and include built-in intelligence to monitor and communicate available power budget versus actually consumed power. The low voltage DC APEQs deliver up to 4725W each. The high voltage DC APEQs take 260-400 V and provide 3,000 W each. AC APEQs take 200-240 V single phase and deliver 3,000 W each with a single input and 4,400 W each with dual inputs. APEQs support cost-effective modular expansion as required.

Fan trays

Fan trays provide system cooling for the 7950 XRS. Redundant fans can be controlled independently and fan speed is linearly modulated to allow for the optimal balancing of cooling, power and noise. The 7950 XRS-20 supports two stacked horizontal fan trays with 1+1 redundancy. The XRS-20e chassis variants support three side-by-side impeller fan trays with 2+1 redundancy.

Switch Fabric Modules (SFMs)

SFMs enable the line-rate connectivity between all slots of a 7950 XRS chassis. The fabric cards are N+1 redundant with active redundancy and graceful capacity degradation in case multiple SFMs fail. The FP4-based SFM2 supports both FP4 and FP3 XCMs and XMA, enabling a simple and cost-efficient upgrade path for existing FP3 configuration by simply replacing the existing FP3-SFM cards.

Control Processor Modules (CPMs)

CPMs provide the management, security and control plane processing for the Nokia 7950 XRS. Redundant CPMs operate in a hitless, stateful, failover mode, and support system upgrades from FP3 to FP4 hardware. Central processing and memory are intentionally separated from the forwarding function on the interface modules to ensure utmost system resiliency. Each CPM contains a full FP3 complex to protect the control plane against denial of service attacks.

Expandable Media Adapters (XMA)

XMA provides the interface options for the 7950 XRS, including high-density GE, 10GE, 40GE, 100GE and 400G interfaces. They contain an FP3 or FP4-based forwarding complex that performs typical functions such as packet lookups, traffic classification, processing and forwarding, service enablement and QoS. Each XMA also provides specific interface ports, physical media and optical functions. The broad range of interface options and slot capacity accommodates different networking roles and deployment needs while protecting their 7950 XRS hardware investments.

XRS Control Modules (XCM)

XMA is equipped in an appropriate XCM. The XCM contains a slot-level control plane subsystem and fabric interface to interconnect to the SFMs via the chassis mid-plane. The XRS-20 and 20e each use dedicated XCM variants, but share the same XMA. The FP3-based XCM variants each deliver 800 Gb/s full duplex slot capacity to a pair of 400G XMA or 200G C-XMA. The FP4-based XCM2 variant for the XRS-20 delivers 3.2 Tb/s full duplex capacity, while the XRS-20e variant delivers 4.8 Tb/s to a pair of FP4 XMA. The flexibility and modularity of XCM and XMA allow network operators to granularly configure each chassis with its desired mix of interface ports to meet the demands of growing core networks.

Technical specifications

Table 1. Technical specifications for the Nokia 7950 XRS family

	7950 XRS-20e	7950 XRS-20
System capacity (half duplex)	16 Tb/s (FP3)/96 Tb/s (FP4)	16Tb/s (FP3)/64 Tb/s (FP4)
System design	Mid-plane	Mid-plane
Interface slots	20	20
Number of XMAs	20 per system	20 per system
Common equipment redundancy	CPM (1+1), CCM (1+1), DC APEQ (N+1), AC APEQ (N+N), SFM (7+1), fan trays (2+1), power termination (1+1)	CPM (1+1), CCM (1+1), DC APEQ (N+1), AC APEQ (N+N), SFM (7+1), fan trays (1+1), power termination (1+1)
Hot-swappable modules	CPM, CCM, XCM, XMA, C-XMA, APEQ, SFM, PIM, PCM, fans	CPM, CCM, XCM, XMA, C-XMA, APEQ, SFM, fans
Dimensions	1 standard 19-in rack 44 RU <ul style="list-style-type: none"> Height: 195.6 cm (77 in) Width: 44.5 cm (17.5 in) Depth: 106.3 cm (41.9 in) 	1 standard 19-in rack 39 RU (44 RU with top plenum) <ul style="list-style-type: none"> Height: 173 cm (68.25 in) Width: 44.5 cm (17.5 in) Depth: 91 cm (36 in)
Weight* (max)	612.35 (1350 lb)	535.2 kg (1180 lb)
Power	<ul style="list-style-type: none"> -48 V DC (12 60A/80A inputs) 260–400 V DC (12 inputs) 200–240 V AC (12 inputs) 	<ul style="list-style-type: none"> -48 V DC (12 60A/80A inputs) 260–400 V DC (12 inputs) 200–240 V AC (12 inputs)
Cooling	Front/bottom to back	Front/bottom to top/back

*Weights and dimensions are approximate and subject to change. Refer to the appropriate installation guide for the current weights and dimensions.

Table 2. Nokia 7950 XRS XMA/C-XMA support per chassis type

XMA types (FP4)	Ports per XMA	Connector type	XRS-20e	XRS-20
10/40/100GE Universal	24	QSFP28	4800/960/480	3200/640/320
400G clear channel	6	CFP8	120	80
XMA types (FP3)			XRS-20e	XRS-20
1GBASE (200G C-XMA)	36/72	SFP/CSFP	720/1440	720/1440
10GBASE (200G C-XMA)	20	SFP+	400	400
10GBASE (400G XMA)	40	SFP+	800	800
40GBASE (200G C-XMA)	6	QSFP+	120	120
100GBASE (200G C-XMA)	2	CFP	40	40
100GBASE (400G XMA)	4	CXP, CFP2	80	80
100G DWDM (200G XMA)	2	LC (OTU4)	40	40
400G DWDM (400G XMA)	1	LC (dual carrier)	20	20

Feature and protocol support highlights

Feature and protocol support within the 7950 XRS family includes, but is not limited to, the following:

IP and MPLS routing features

- IP unicast routing: Routing Information Protocol (RIP), Intermediate System-to-Intermediate System (IS-IS), Open Shortest Path First (OSPF), Multiprotocol Border Gateway Protocol (MBGP), Unicast Reverse Path Forwarding (uRPF), comprehensive control plane protection features for security, and IPv4 and IPv6 feature parity
- IP multicast routing: Internet Group Management Protocol (IGMP), Multicast Listener Discovery (MLD), Protocol Independent Multicast (PIM), Multicast Source Discovery Protocol (MSDP), and IPv4 and IPv6 feature parity
- MPLS: Label edge router (LER) and label switch router (LSR) functions with support for seamless MPLS designs, MPLS-Transport Profile (MPLS-TP), Label Distribution Protocol (LDP) and Resource Reservation Protocol (RSVP) for MPLS signaling and traffic engineering, Point-to-Point (P2P) and Point-to-Multipoint (P2MP) label switched paths (LSPs) with Multicast LDP (MLDP), P2MP RSVP and weighted Equal-Cost Multi-Path (ECMP)

Segment routing and SDN features

- Multiple instance IS-IS and OSPF Segment Routing support with shortest path tunnel, Segment Routing Traffic Engineering (SR-TE) LSP, and static and BGP SR policy. The implementation provides LFA, remote LFA and Topology-Independent LFA (TI-LFA) protection for all types of tunnels. PCEP allows the delegation of the SR-TE LSP to the Nokia NSP or a third-party PCE function.
- Programmable forwarding tables via gRPC-based RIB API feature and MPLS forwarding policy
- Extensive set of capabilities using access control list (ACL) logic to steer routes/flows toward various target types, such as IP next-hop SR-TE/RSVP-TE LSP/MPLS-TP and virtual routing and forwarding (VRF), and in a wide range of routing and service contexts such as Global Routing table,

Virtual Private Routed Network (VPRN), Virtual Private LAN Service (VPLS) and Epipe service; supports control interfaces such as OpenFlow, FlowSpec, CLI and NETCONF

- Multivendor SDN control integration through OpenFlow, PCEP, BGP-LS and BGP SR Policy support

Layer 2 features

- Ethernet LAN (ELAN): BGP-VPLS (Virtual Private LAN Service), Provider Backbone Bridging for VPLS (PBB-VPLS), Ethernet VPN (EVPN) and PBB-EVPN
- E-Line: BGP-VPWS (Virtual Private Wire Service), EVPN-VPWS and PBB-EVPN
- E-Tree: EVPN and PBB-EVPN
- EVPN: EVPN-VXLAN (Virtual eXtensible LAN) to VPLS/EVPN-MPLS gateway functions
- E-Tree: EVPN and PBB

Layer 3 features

- IP-VPN, enhanced internet services, EVPN for Layer 3 services with integrated routing and bridging (EVPN-IRB), and Multicast VPN (MVPN), which includes Inter-AS MVPN and Next Generation MVPN (NG-MVPN)

System features

- Ethernet satellites: Port expansion through local or remote Nokia 7210 SAS-S series GE, 10GE, 100GE and SONET/SDH satellite variants, offering 24/48xGE ports, 64xGE/10GE ports or legacy SONET/SDH ports over GE, 10GE and 100GE uplinks
- OAM: Extensive fault and performance operations, administration and maintenance (OAM) includes Ethernet Connectivity Fault Management (CFM) (IEEE 802.1ag, ITU-T Y.1731), Ethernet in the First Mile (EFM) (IEEE 802.3ah), Bi-Directional Fault Detection (BFD), Cflowd, Two-Way Active Measurement Protocol (TWAMP), and a full suite of MPLS OAM tools, including GMPLS UNI
- Timing: ITU-T Synchronous Ethernet (SyncE), IEEE 1588v2, Network Time Protocol (NTP), BITS ports (T1, E1, 2M), and 1PPS

- QoS: Flexible intelligent packet classification; ingress and egress hierarchical QoS with multitiered shaping and two-tiered, class fair hierarchical policing; advanced, scalable network and service QoS, and end-to-end consistent QoS regardless of oversubscription or congestion
- High availability: Nonstop routing, nonstop services, ISSU, fast reroute for IP, RSVP, LDP and segment routing, pseudowire redundancy, ITU-T G.8031 and G.8032, weighted ECMP, and weighted, mixed-speed link aggregation

Management features

- Model-driven network element management through CLI, NETCONF and gRPC/gNMI using YANG models
- Full SNMP management support, including configuration
- Comprehensive network and node management through the Nokia NSP

Environmental specifications

- Operating temperature: 5°C to 40°C (41°F to 104°F)
- Operating relative humidity: 5% to 85%
- Operating altitude: Up to 4000 m (13,123 ft) at 30°C (86°F)

Safety standards and compliance agency certifications

- IEC/EN/UL/CSA 60950-1
- FDA CDRH 21-CFR 1040
- IEC/EN 60825-1 (applies to optical receivers)
- IEC/EN 60825-2 (applies to optical receivers)

EMC emission

- ICES-003 Class A (with EMI/Protection panel)
- FCC Part 15, Subpart B, Class A (with EMI/Protection panel)
- EN 55032 Class A
- CISPR 32 Class A
- AS/NZS CISPR 32 Class A
- VCCI Class A

- KN 32 Class A
- EN 61000-3-2
- EN 61000-3-3
- EN 61000-6-4, Class A
- ETSI EN 300 386, Class A

EMC immunity

- ETSI EN 300 386
- EN 55024
- KN 35
- CISPR 24
- BTGS7
- EN61000-6-2 Immunity for industrial environments
- EN 61000-4-2 Electric Static Discharge
- EN 61000-4-3 Radiated, RF, EM field immunity
- EN 61000-4-4 Electrical Fast Transients
- EN 61000-4-5 Surge Immunity
- EN 61000-4-6 Immunity to conducted disturbances
- EN 61000-4-11 Voltage dips & short interruptions

Environmental

- ETSI EN 300 019-2-1 Storage Tests, Class 1.2
- ETSI EN 300 019-2-2 Transportation Tests, Class 2.3
- ETSI EN 300 019-2-3 Operational Tests, Class 3.2
- ETSI EN 300 019-2-4, pr A 1 Seismic
- ETSI EN 300 132-2 DC Power Supply Interface
- ETSI EN 300 132-3-1 HVDC Power Supply Interface
- WEEE
- RoHS
- China CRoHS



Network Equipment Building System (NEBS)

- NEBS Level 3
- GR-1089-CORE
- GR-63-CORE
- RBOC requirements
 - ATIS-0600015.03
 - ATT-TP-76200
 - VZ.TPR.9205
 - VZ.TPR.9305

MEF certifications

- CE 2.0
 - Certified (on E-LAN, E-Line, E-Tree and E-Access MEF service types)
 - 100G Certified (on E-Line and E-Access MEF service types)
- CE 1.0 (MEF 9 and MEF 14) Certified

The system design intent is per the specification and standards listing. Refer to product documentation for detailed compliance status and protocol standards support.

About Nokia

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